Short Communication

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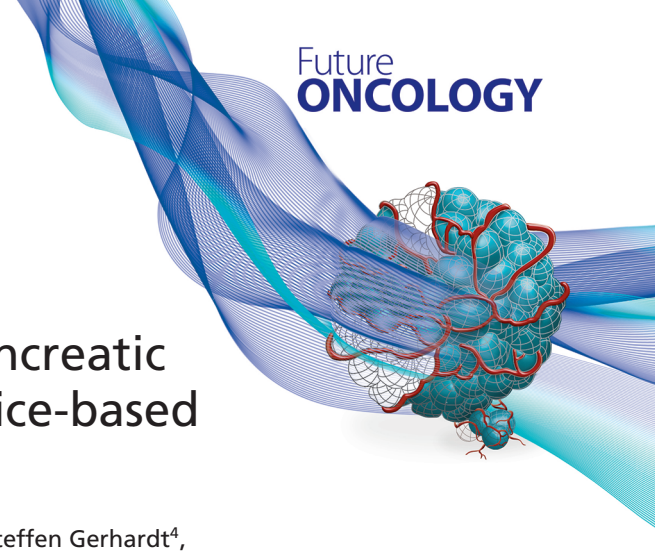

Current treatment landscape of pancreatic cancer patients in a network of office-based oncologists in Germany

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Background: Pancreatic cancer is one of the most aggressive cancers, with comparatively poor outcomes despite the use of multiagent conventional chemotherapy regimens. Real-world data from clinical practice are still rare but are the basis for understanding and improving the current standard of care. **Materials & methods:** In this multi-institutional retrospective analysis of 24 office-based oncology practices in Germany, the authors documented 1786 pancreatic cancer patients who received systemic treatment between April 2017 and June 2021. **Results:** The authors' analysis showed that results from recent clinical studies are promptly incorporated into practice. **Conclusion:** It was striking that, during the analyzed period, the use of platinum-based therapy regimens in adjuvant and palliative first-line therapy increased predominantly in younger patients (<70 years).

Plain language summary: Cancer of the pancreas is one of the most aggressive cancers, with poor survival despite the use of strong chemotherapy. Data from clinical practice are still rare but are the basis for understanding and improving the current standard of care. In this analysis of 24 office-based oncology practices in Germany, the authors documented treatment data of 1786 patients with pancreatic cancer who received chemotherapy between April 2017 and June 2021. The authors' analysis shows that results from recent clinical studies are promptly integrated into practice. The use of a certain type of chemotherapy with platinum increased, especially in patients younger than 70 years of age.

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Keywords: adjuvant therapy • chemotherapy • clinical practice • palliative care • palliative first-line therapy • pancreatic cancer • platinum-based therapy • real-world data • systemic treatments

The incidence of pancreatic cancer in the German population is slowly increasing and currently represents approximately 3.8% of all malignancies [1]. Pancreatic cancer continues to be associated with high mortality. In Germany, for example, the 5-year survival rate of approximately 6–10% in patients aged 65–74 has not changed since 2007 and is even lower (3–5%) in older patients (≥70). The mean age of onset of pancreatic cancer is approximately 74 years.

Pancreatic cancer is difficult to treat because it is characterized by unique tumor biology, specific tumor microenvironment, formation of early metastases and predominantly late diagnosis. Because of a lack of specific symptoms in the early stages and no effective screening program, approximately 75% of patients are diagnosed with locally advanced or metastatic disease, and the majority of initially resectable patients eventually develop metastatic disease [2,3].

Pancreatic cancer is highly heterogeneous because its tumor microenvironment evolves dynamically during tumor progression and consists of different non-neoplastic cells, including cancer-associated fibroblasts, immune cells, endothelial cells and neurons. The tumor microenvironment, the extracellular matrix and the cellular genetic or epigenetic alterations of pancreatic cancer represent physical and biological barriers against effective therapies, including radiotherapy, targeted therapy, immunotherapy and chemotherapy [4–8].

The only potentially curative treatment for pancreatic cancer is surgical resection with tumor-free margins, but only 15–20% of patients are eligible for resection at initial diagnosis. The 5-year overall survival of patients receiving gemcitabine as adjuvant chemotherapy is approximately 20%. For those who are fit enough to receive folinic acid, fluorouracil, irinotecan and oxaliplatin (FOLFIRINOX), disease-free survival at 3 years is 39.7%, and median overall survival may be improved to 54 months [9,10]. The challenging tumor properties of pancreatic cancer contribute to its devastating prognosis, which highlights the high unmet medical need for new therapies.

Systemic chemotherapy regimens based on fluorouracil (5-FU, since 1962) or gemcitabine (since 1997) continue to play a major role as standard of care in patients with pancreatic cancer [11]. After the introduction of gemcitabine, different gemcitabine-based combination chemotherapies were established in locally advanced or metastatic pancreatic cancer [12,13]. In 2007, the first targeted therapy option of erlotinib (tyrosine kinase receptor inhibitor) in combination with gemcitabine was approved for the treatment of advanced pancreatic cancer in Europe [14]. In 2011, the combination of 5-FU, leucovorin (LV), irinotecan and oxaliplatin (FOLFIRINOX) versus a monotherapy with gemcitabine in advanced pancreatic cancer showed a survival advantage at increased toxicity [15]. Currently, FOLFIRINOX is a first-line option for the treatment of patients with metastatic pancreatic cancer and good performance status (Eastern Cooperative Oncology Group [ECOG] performance status 0–1) [15]. Further improvements were established in clinical practice in 2013, with nanoparticle albumin-bound (nab) paclitaxel plus gemcitabine significantly improving overall survival, progression-free survival and response rate in patients with metastatic pancreatic adenocarcinoma; however, rates of peripheral neuropathy and myelosuppression were also increased [16].

Current research addresses whether, among several first-line options, a particular choice of first-line regimen and/or sequence may provide further benefits for patients. For example, a systematic review and meta-analysis investigating the comparative effectiveness of gemcitabine plus nab-paclitaxel and FOLFIRINOX in the first-line setting of metastatic pancreatic cancer showed different toxicity profiles, with less nausea, neutropenia and febrile neutropenia with gemcitabine plus nab-paclitaxel versus less neurotoxicity and anemia with FOLFIRINOX [17]. However, this analysis provided no evidence of a major benefit with one regimen over the other. Taken together, the results do not show any significant difference in the choice of first-line chemotherapy, demanding further research regarding the optimal treatment sequence.

Further research for a second-line option with a combination of nanoliposomal irinotecan and fluorouracil/folinic acid showed extended survival with a manageable safety profile in patients with metastatic pancreatic ductal adenocarcinoma who previously received gemcitabine-based therapy in the adjuvant or metastatic setting [18]. However, drug therapy was updated in 2021 for certain subgroups, such as patients with metastatic pancreatic cancer and a germline mutation in *BRCA1* or *BRCA2*, which is present in approximately 4–7% of patients [19,20]. The recently updated German S3 guideline for exocrine pancreatic cancer recommends platinum-based first-line therapy for these patients. The guideline furthermore states that substances interfering with DNA repair mechanisms, such as PARP inhibitors, are important in the maintenance therapy of metastatic pancreatic carcinoma after prior platinum-based therapy in patients with *BRCA1/2* germline mutations [19,20].

The standard of care in the first-line setting continues to consist of cytotoxic chemotherapy, primarily FOLFIRINOX and gemcitabine-based regimens [21]. The collection of routine data from oncology practices provides important indicators regarding the potential for improvements in everyday treatment. Taking recent developments in the clinical management of patients with pancreatic cancer into account, the authors' aim was to determine the impact of newer therapeutic options on the current treatment landscape in Germany. The authors especially focused on the duration of first-line platinum-containing therapies in order to assess the rare and potential treatment option with PARP inhibitors in patients with *BRCA1/2* germline mutations [20].

Materials & methods

For this multicenter, retrospective observational analysis, data were collected via oncotrace® software (alanta health group GmbH, Hamburg, Germany) between April 2017 and June 2021 from 24 office-based oncology practices, including 82 physicians in Germany within the Onkotrakt network (www.onkotrakt.de). Oncotrace is a practice

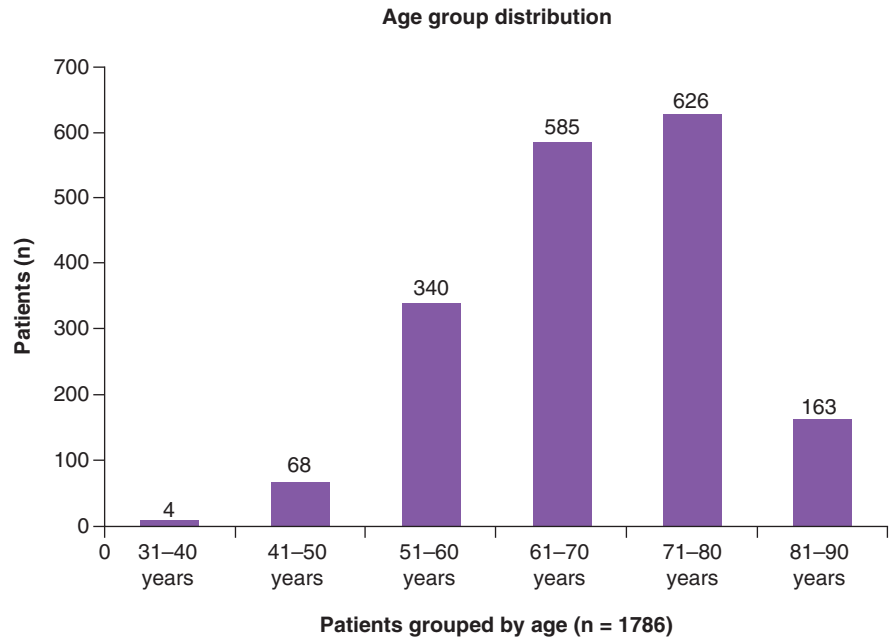

Figure 1. Age group distribution of patients diagnosed with pancreatic cancer (n = 1786). The two dominant age groups were 61–70 (n = 585) and 71–80 (n = 626), accounting for a total of 68% of patients.

software used to plan and order chemotherapy, thus allowing all orders to be tracked seamlessly and permitting changes in the therapy landscape to be reliably tracked over time. Data from the oncotrace software system are systematically recorded in the participating practices and, after pseudonymization, sent to Onkotrakt AG (Hamburg, Germany) for analysis preparation. In this way, the course of the disease and the therapy lines can be recorded longitudinally in the disease-specific real-world data register 'LiveTicker', which was established in Germany in 2011. The goal of the LiveTicker trial is to continuously collect registry data for mapping patient care management in oncology treatment in Germany (WHO clinical trial search portal trial number: DRKS00013113). Anonymized treatment data of 1786 patients diagnosed with pancreatic cancer (diagnostic ICD-10 Code C25) in the participating centers were evaluated with SPSS software (IBM Corporation, NY, USA) for descriptive statistical evaluation. The evaluation included baseline patient characteristics, therapy settings, frequency of adjuvant and palliative first-line therapies and treatment duration. Reported treatment regimens were determined by the physicians, and treatment settings were entered by the treating physicians. Data were collected over a period of 51 months and were updated every 3 months.

Results

Demographics & baseline characteristics

Sex was distributed almost equally (929 men [52%] and 857 women [48%]) in this cohort. The median age at the beginning of treatment was 68. A total of 44% of patients were older than 70. The two dominant age groups were 61–70 (n = 585) and 71–80 (n = 626), accounting for a total of 68% of patients (Figure 1).

This analysis focused on changes with regard to adjuvant and first-line therapy protocols for pancreatic cancer. The vast majority of patients were treated with palliative intent (80%; mean age: 69) (Table 1) followed by adjuvant regimens (25.7%; mean age: 67). A minor population (4.5%) received neoadjuvant therapies. Some patients may have been treated with different lines during the documentation period. A proportion of patients who received adjuvant (n = 106) or neoadjuvant therapy also received palliative therapy, and palliative first-line therapies were initiated in 1202 patients.

Adjuvant regimens

The top three most commonly used adjuvant therapies (n = 459) were gemcitabine monotherapy (43.6%), FOLFIRINOX (33.3%) and gemcitabine in combination with capecitabine (19.0%). The proportion of patients treated with FOLFIRINOX increased significantly after publication of the PRODIGE trial [9] in December 2018,

Table 1. Median age at start of therapy according to regimen and therapy line.

Regimen and therapy line	Median age (years)
Start of therapy (all)	68
Start of adjuvant therapy	67
Start of FOLFIRINOX	61
Adjuvant therapy except FOLFIRINOX	71
Start of adjuvant gemcitabine monotherapy	74
First-line palliative therapy (all)	69
First-line palliative FOLFIRINOX	62
First-line palliative therapy except FOLFIRINOX	73
Start of first-line palliative gemcitabine monotherapy	78

FOLFIRINOX: Folinic acid, fluorouracil, irinotecan and oxaliplatin.

from 4.5% in April 2017 to approximately 50% in June 2021, whereas there was a concomitant decrease in the use of the far less effective treatment gemcitabine plus capecitabine (ESPAC trial [22]), declining from 30 to 10% in the same time period. A similar trend was observed for gemcitabine monotherapy (from 65% in April 2017 to 34% in the second quarter of 2021) (Figure 2A & B).

The comparison between younger (<70; n = 266) and older (≥70; n = 595) patients showed a significant difference in median age between FOLFIRINOX (median age: 61) and gemcitabine monotherapy (median age: 74). FOLFIRINOX predominated in the <70 age group (45.1 vs 7.9% for ≥70), whereas gemcitabine showed the highest proportion in patients aged ≥70 (71.3 vs 27.7% for <70). The use of gemcitabine plus capecitabine was more equally distributed between the two age groups (22.1% for <70 vs 17.1% for ≥70) (Figure 3).

Palliative first-line therapies

The three most common palliative first-line therapies (n = 1202) consisted of gemcitabine plus nab-paclitaxel (42.7%; median age: 71), FOLFIRINOX (28.2%; median age: 62) and gemcitabine monotherapy (22.4%; median age: 78) (Figure 4).

As was observed for the adjuvant setting, the frequency of applied therapy protocols, although less pronounced, changed over time. The proportion of patients treated with FOLFIRINOX increased from 23.6 to 37.5%, whereas the proportion of patients treated with gemcitabine plus nab-paclitaxel dropped slightly, from 50.0 to 45.8%. Gemcitabine monotherapy dropped more significantly over this time period, from 25.5 to 9.7%, most likely reflecting the increasing acceptance of nab-paclitaxel as a treatment option for older patients (Figure 5).

Use of the FOLFIRINOX regimen declined from 60.0% in patients aged <55 to 2.3% in patients aged >75. By contrast, treating physicians more often prescribed gemcitabine as monotherapy in patients aged >75 (49.0 vs 5.0% in patients aged <55). The use of gemcitabine plus nab-paclitaxel increased from 23.0% in patients aged <55 to 45.3% in patients aged >75. Gemcitabine plus nab-paclitaxel was more common palliative first-line chemotherapy in patients aged ≥70 than in patients aged <70 (48.7 vs 36.7%). In addition, gemcitabine as monotherapy was predominantly given in patients aged ≥70 compared with patients aged <70 (37.6 vs 7.4%). No other regimens showed a distinct pattern (Figure 6A & B).

The majority (56%) of patients treated with first-line FOLFIRINOX (n = 297) received treatment for at least 4 months. The number of cycles (cycle interval: 2 weeks) of FOLFIRINOX varied from one to 67, with 12 being the most common (>20.5%). Approximately 50.2% of patients receiving FOLFIRINOX as first-line therapy were treated with eight or more cycles (Figure 7).

Second-line palliative therapy was documented for 534 patients. The top three therapies were gemcitabine plus nab-paclitaxel (41.0%), fluorouracil plus folinic acid plus nanoliposomal irinotecan (19.5%) and gemcitabine monotherapy (12.7%) (Figure 8).

Discussion

Outside of a typical clinical trial, the only way to gather evidence concerning changes in clinical practice is by analyzing real-world data. Here the authors describe real-world data in a network of office-based oncologists in Germany. The median age in clinical trials typically varies between 57 and 63 years, whereas in everyday practice within the Onkotrakt network in Germany, the median age is 68 years. For example, in comparison with the

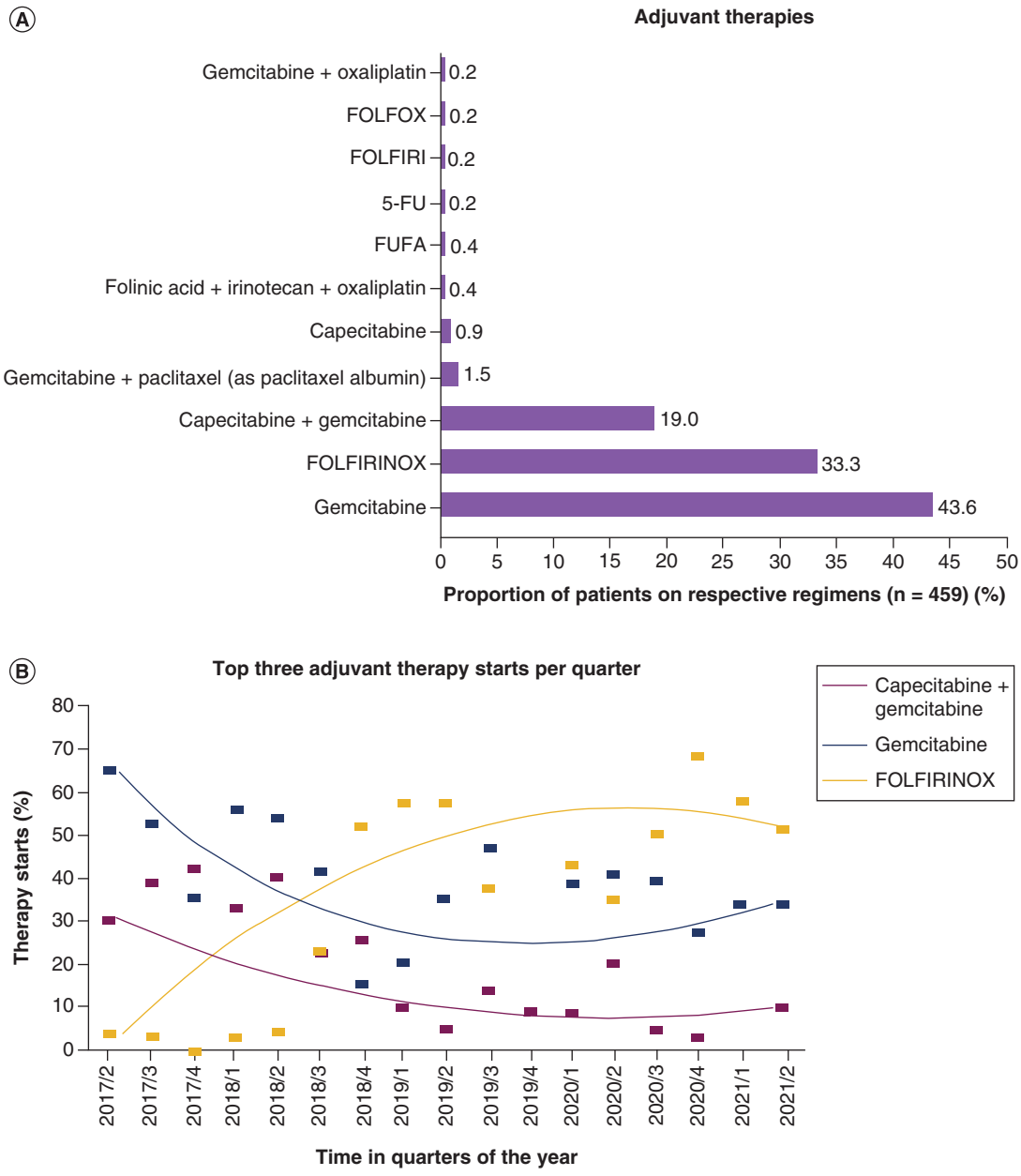

Figure 2. Adjuvant therapies. (A) Frequency of adjuvant therapies and therapy protocols over time between April 2017 and June 2021 (n = 459). Gemcitabine as monotherapy (43.6%) and in combination with capecitabine (19.0%) were the most common adjuvant therapies. A folinic acid, fluorouracil, irinotecan and oxaliplatin regimen was also frequently used (33.3%). **(B)** Top three adjuvant therapy starts for pancreatic cancer (C25) per quarter in %. A comparison of the top three regimens in adjuvant therapy – a folinic acid, fluorouracil, irinotecan and oxaliplatin regimen and gemcitabine as monotherapy or in combination with capecitabine – shows that the proportion of patients treated with a folinic acid, fluorouracil, irinotecan and oxaliplatin regimen increased after publication of the PRODIGE study from 4.5 to 50.0%, whereas the proportion of patients treated with gemcitabine plus capecitabine (based on the ESPAC study) declined from 30.0 to 10.0%. Data presented as polynomial trend lines of adjuvant therapies started per quarter.
5-FU: 5-Fluorouracil; FOLFIRI: Folinic acid, 5-fluorouracil, irinotecan; FOLFOX: Folinic acid, 5-fluorouracil, oxaliplatin; FOLFIRINOX: 5-Fluorouracil, folinic acid, irinotecan, oxaliplatin; FUFA: 5-Fluorouracil, folinic acid.

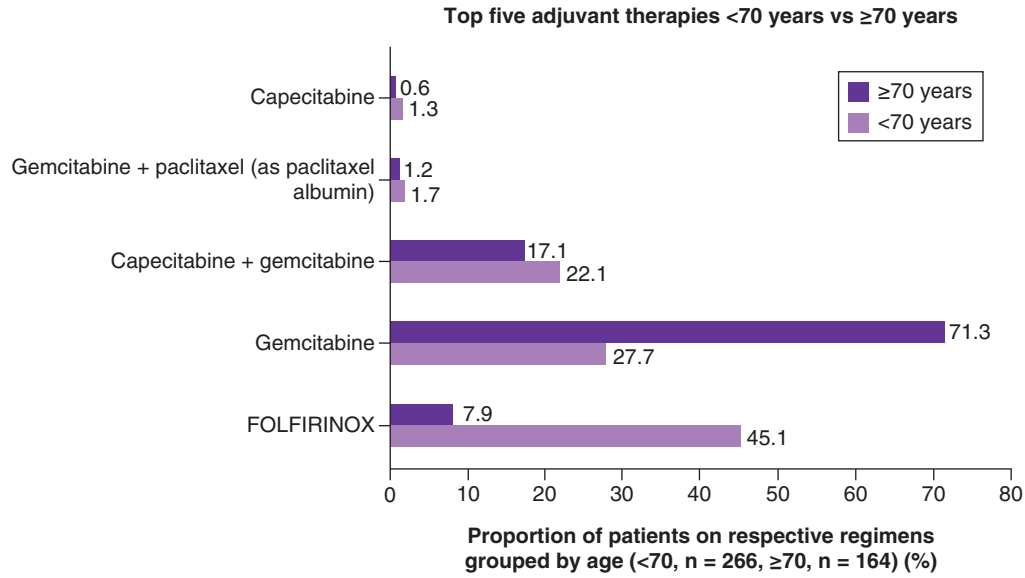

Figure 3. Top five adjuvant therapies by patient age in years (<70: n = 266; ≥70: n = 164). Adjuvant therapies by patient age and age group at the beginning of treatment. A folinic acid, fluorouracil, irinotecan and oxaliplatin regimen predominated in the <70 age group (45.1 vs 7.9% for ≥70), whereas gemcitabine monotherapy showed the highest proportion in patients aged ≥70 (71.3 vs 27.7% for <70). The use of gemcitabine plus capecitabine was more equally distributed between the two age groups (22.1% for <70 vs 17.1% for ≥70).
FOLFIRINOX: 5-Fluorouracil, folinic acid, irinotecan, oxaliplatin.

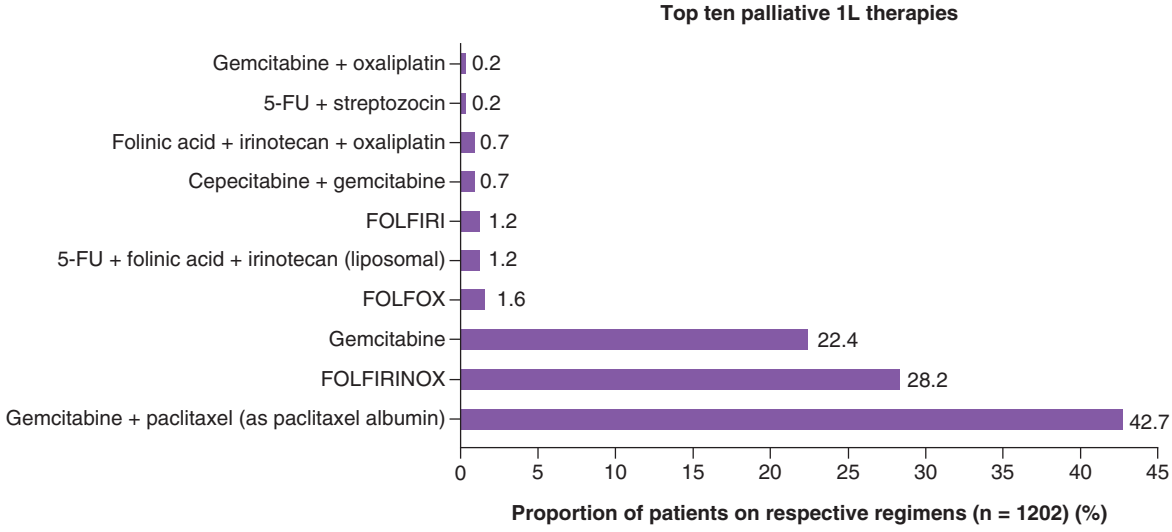

Figure 4. Top ten palliative first-line therapies (n = 1202). The three most common palliative first-line therapies consisted of gemcitabine plus nanoparticle albumin-bound paclitaxel (42.7%; median age: 71); a folinic acid, fluorouracil, irinotecan and oxaliplatin regimen (28.2%; median age: 62); and gemcitabine monotherapy (22.4%; median age: 78).
1L: First-line; 5-FU: 5-Fluorouracil; FOLFIRI: Folinic acid, 5-fluorouracil, irinotecan; FOLFOX: Folinic acid, 5-fluorouracil, oxaliplatin; FOLFIRINOX: 5-Fluorouracil, folinic acid, irinotecan, oxaliplatin.

PRODIGE study, the median age in the present study was higher, especially in the gemcitabine monotherapy group (PRODIGE study: median age in the modified FOLFIRINOX arm: 63 years; in the gemcitabine monotherapy arm: 64 years) [9]. This is typical for real-world evidence studies, where patient cohorts tend to be older and have more comorbidities and lower performance status [23].

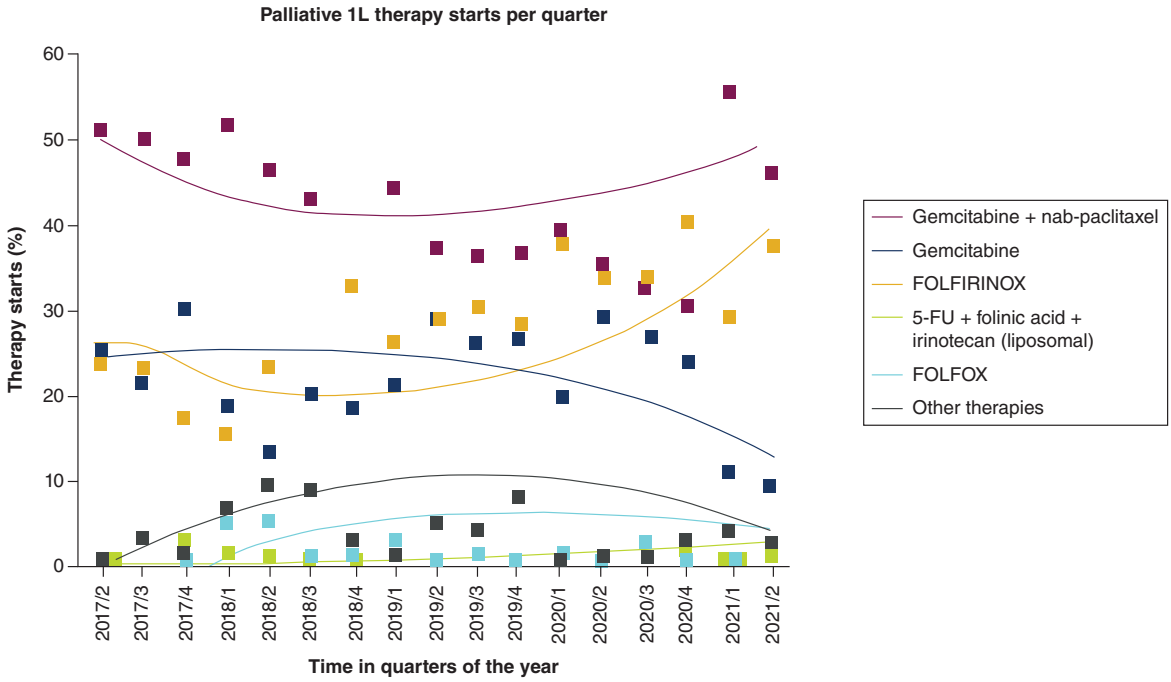

Figure 5. Palliative first-line therapies over time. The proportion of patients treated with a folinic acid, fluorouracil, irinotecan and oxaliplatin regimen increased slightly, from 23.6 to 37.5%, whereas the proportion of patients treated with gemcitabine plus nanoparticle albumin-bound paclitaxel dropped slightly, from 50.0 to 45.8%. Gemcitabine monotherapy dropped more significantly, from 25.5 to 9.7%.
1L: First-line; 5-FU: 5-Fluorouracil; FOLFOX: Folinic acid, 5-fluorouracil, oxaliplatin; FOLFIRINOX: 5-Fluorouracil, folinic acid, irinotecan, oxaliplatin.

The main purpose of this analysis was to determine whether and in what time frame data from pivotal and large phase III trials testing new treatment options would find their way into everyday practice. Although this analysis has limitations with regard to baseline patient characteristics and sample size as well as missing data for ECOG performance status, tumor staging, localization of metastases and adverse events, including toxicity, the data show rapid implementation of available clinical trial (e.g., PRODIGE and ESPAC) findings into daily clinical practice and, ultimately, guidelines, such as the German S3 guideline mentioned earlier [9,19,20,22].

The proportion of platinum-based treatment protocols with FOLFIRINOX increased significantly following publication of the results of the PRODIGE trial in 2018 in both the adjuvant and palliative first-line setting during the observation period, from 4.5 and 23.6% in April 2017 to approximately 50 and 37.5% in June 2021, respectively. In everyday practice, patient age and performance status at the beginning of therapy are critical aspects of the choice of treatment. The proportion of platinum-based treatment protocols is significantly high and almost equal for each setting (45.1% for adjuvant and 47.3% for palliative), especially in younger patients (<70 years). This is also reflected in the recent German S3 guideline for exocrine pancreatic cancer, which states that FOLFIRINOX should be offered to patients with metastatic pancreatic cancer if the following criteria are met: ECOG performance status 0–1, favorable comorbidity profile, patient preference and adequate supportive care options [19]. Only 7.9% (adjuvant) and 8.7% (first-line palliative) of patients aged ≥70 were treated with FOLFIRINOX, whereas gemcitabine-based combinations were more common in patients aged ≥70 than in patients aged <70. Also of interest is the low use of fluorouracil/nanoliposomal irinotecan as first-line palliative therapy, which may reflect the increasing use of FOLFIRINOX in the adjuvant setting.

Since 2018, the modified FOLFIRINOX regime with a lower dose of irinotecan and no bolus fluorouracil in comparison to the full FOLFIRINOX regime, is gaining importance in clinical practice. A 2018 study concluded that modified FOLFIRINOX offers comparative survival benefits with fewer adverse events compared with conventional dosing [24]. More recently published data in patients with advanced pancreatic ductal adenocarcinoma treated with first-line modified FOLFIRINOX supported these data and showed good feasibility with similar therapeutic benefits compared with unmodified FOLFIRINOX [25]. In the present analysis, a total of 189 patients received

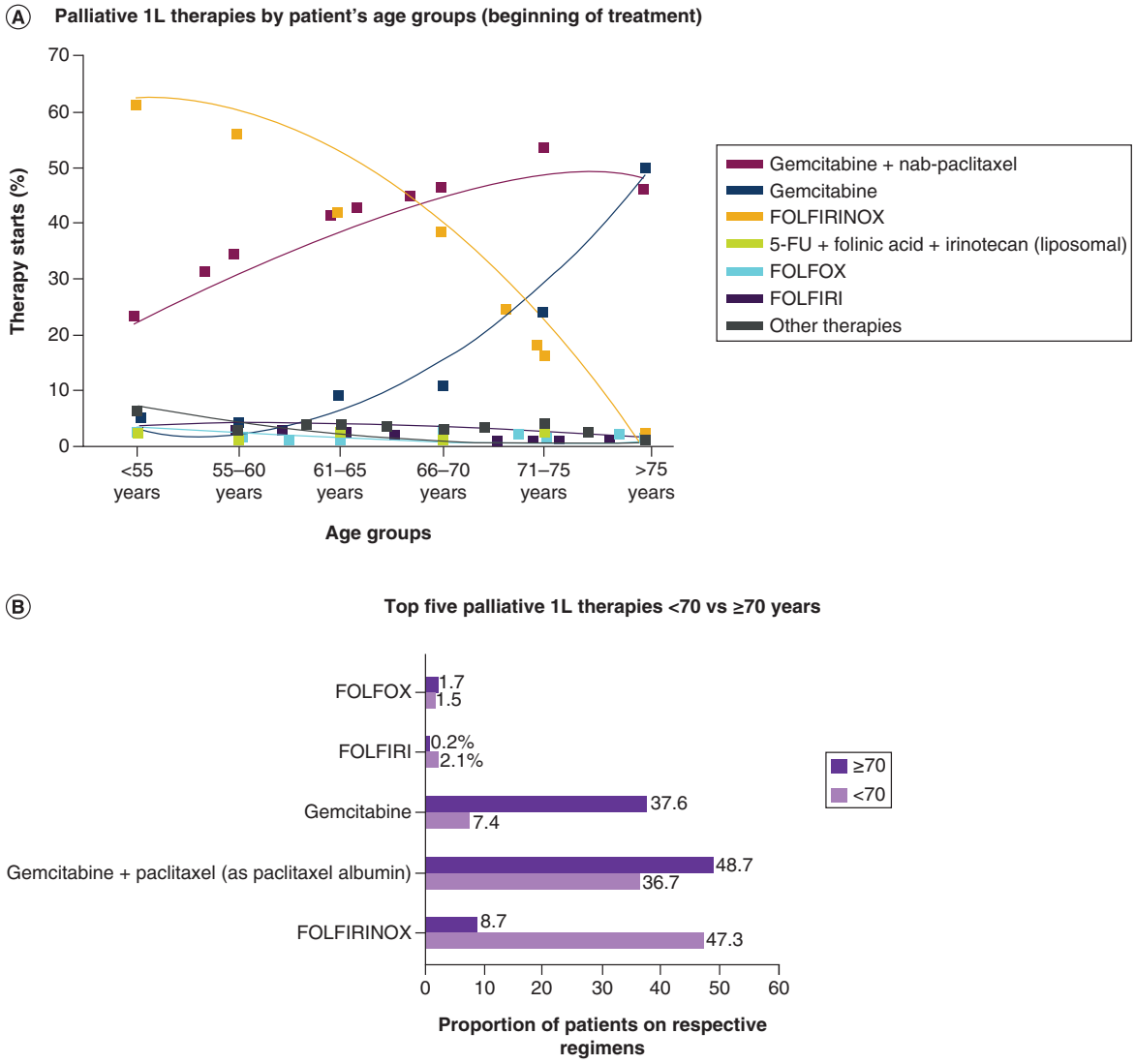

Figure 6. Palliative therapies. (A) In palliative first-line therapies (n = 1202) related to patient age group at the beginning of treatment, the folinic acid, fluorouracil, irinotecan and oxaliplatin regimen declined from 60.0% in patients aged <55 to 2.3% in patients aged >75. By contrast, treatment with gemcitabine as monotherapy increased from 5.0% in patients aged <55 to 49.0% in patients aged >75. The use of gemcitabine plus nanoparticle albumin-bound paclitaxel increased from 23.0% in patients aged <55 to 45.3% in patients aged >75. **(B)** Top five palliative first-line therapies by patient age (<70 or ≥70). Among the age groups (<70: n = 607; ≥70: n = 595), gemcitabine plus nanoparticle albumin-bound paclitaxel was common palliative first-line chemotherapy, with a higher proportion of use in patients aged ≥70 (48.7 vs 36.7% for <70). Gemcitabine as monotherapy also predominated in patients aged ≥70 (37.6 vs 7.4% for <70). The folinic acid, fluorouracil, irinotecan and oxaliplatin regimen predominated in patients aged <70 (47.3 vs 8.7% for ≥70).
1L: First-line; 5-FU: 5-Fluorouracil; FOLFIRI: Folinic acid, 5-fluorouracil, irinotecan; FOLFOX: Folinic acid, 5-fluorouracil, oxaliplatin; FOLFIRINOX: 5-Fluorouracil, folinic acid, irinotecan, oxaliplatin

modified dosing with irinotecan (between 120 and 150 mg/m^2), mostly in adjuvant (n = 90), first-line palliative (n = 79) and neoadjuvant (n = 14) settings.

Overall treatment outcomes for metastatic pancreatic cancer have significantly improved since the introduction of modified FOLFIRINOX and gemcitabine plus nab-paclitaxel combination therapy. Modified FOLFIRINOX is certainly preferred in patients presenting at a younger age with good performance status, whereas gemcitabine/nab-paclitaxel or gemcitabine monotherapy is the dominant treatment choice in patients aged ≥70. In principle, these results are in line with the authors' findings with regard to the treatment landscape in Germany, where regimens with modified FOLFIRINOX, rather than unmodified FOLFIRINOX, are predominantly conducted [10].

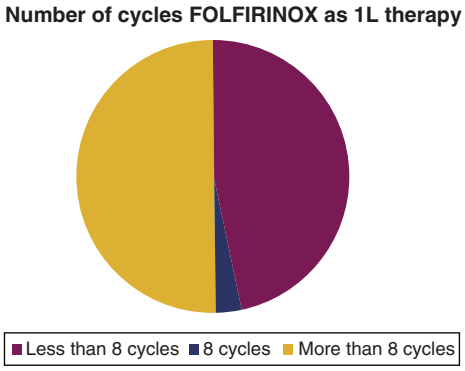

Figure 7. Number of cycles of first-line folinic acid, fluorouracil, irinotecan and oxaliplatin. The majority (56%) of patients treated with a first-line folinic acid, fluorouracil, irinotecan and oxaliplatin regimen (n = 297) received the treatment for at least 4 months. The number of cycles (cycle interval: 2 weeks) of folinic acid, fluorouracil, irinotecan and oxaliplatin varied from one to 67, with 12 being the most common (>20.5%). Approximately 50.2% of patients were treated with eight or more cycles of folinic acid, fluorouracil, irinotecan and oxaliplatin.
1L: First-line; FOLFIRINOX: 5-Fluorouracil, folinic acid, irinotecan, oxaliplatin.

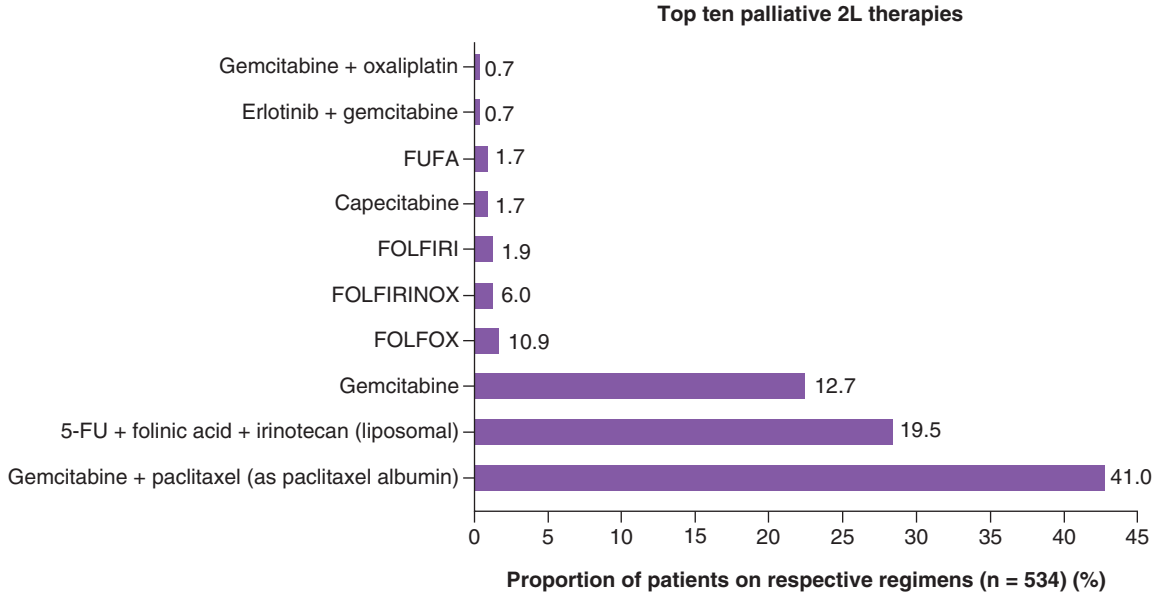

Figure 8. Top ten palliative second-line therapies (n = 534). The top three therapies were gemcitabine plus nanoparticle albumin-bound paclitaxel (41.0%), fluorouracil plus folinic acid plus nanoliposomal irinotecan (19.5%) and gemcitabine monotherapy (12.7%).
2L: Second-line; 5-FU: 5-Fluorouracil; FOLFIRI: Folinic acid, 5-fluorouracil, irinotecan; FOLFOX: Folinic acid, 5-fluorouracil, oxaliplatin; FOLFIRINOX: 5-Fluorouracil, folinic acid, irinotecan, oxaliplatin; FUFA: 5-Fluorouracil, folinic acid.

In the Onkotrakt network, the majority of patients who received first-line modified FOLFIRINOX (56%) were treated for at least 4 months (n = 297). Recently published data of a phase II trial recommended 4 months of FOLFIRINOX followed by folinic acid plus fluorouracil maintenance treatment for controlled patients [26]. This regimen showed a benefit in 6-month progression-free and overall survival in comparison with 6 months of FOLFIRINOX or sequential treatment alternating gemcitabine and fluorouracil, folinic acid and irinotecan every 2 months.

With regard to maintenance, depending on certain molecular genetic changes, such as *BRCA*-mutated metastatic pancreatic cancer, the options for targeted therapy in pancreatic cancer are increasing [27]. The POLO trial investigated active maintenance therapy with the PARP inhibitor olaparib in patients with germline *BRCA*-mutated metastatic pancreatic cancer after at least 16 weeks of first-line platinum-based therapy (inclusion criterion) [20]. Based on the POLO results, the recently updated German S3 guideline recommends platinum-based first-line therapy for exocrine pancreatic cancer patients. The guideline further states that substances that interfere with DNA repair mechanisms, such as PARP inhibitors, are important in the maintenance therapy of metastatic pancreatic carcinoma after prior platinum-based therapy [19]. Compared with placebo, median progression-free survival was longer (7.4 vs 3.8 months). Overall survival was not significantly different, but median duration of study treatment

among long-term survivors was 25.9 months in the olaparib arm and 7.3 months in the placebo arm [28]. Olaparib is approved in the US and EU as active maintenance treatment of germline *BRCA*-mutated metastatic pancreatic cancer following 16 weeks of platinum-based chemotherapy [29]. In the authors' data, the proportion of patients fulfilling the criterion of 16 weeks of pretreatment reached at least 50%. Therefore, a significant proportion of patients testing positive for *BRCA* mutations (4–7%) may qualify for active maintenance therapy with a PARP inhibitor. In the present study, only one patient was treated with olaparib in a more than third-line palliative setting, which suggests that the use of olaparib could be further expanded in the near future. In clinical practice, it should definitely be worthwhile to initiate a test for *BRCA* mutations at the beginning of FOLFIRINOX therapy [19,20].

Study limitations

This analysis has limitations with regard to baseline patient characteristics and sample size as well as missing data for ECOG performance status, tumor staging, localization of metastases, *BRCA1/2* germline mutations and adverse events, including toxicity. Furthermore, some demographics differ from data obtained in clinical studies. The scope of the current study was not the collection of the aforementioned parameters, as in a clinical study, but primarily the collection of real-world prescription data (routine data from oncology practices) using a specific medication software.

Conclusion

The authors' analysis of the treatment reality in a network of practice-oriented oncologists in Germany suggests that results from recent clinical studies are promptly incorporated into practice. The proportion of platinum-based treatment protocols increased in both adjuvant and palliative first-line therapy during the observation period, especially in younger patients (<70 years).

Summary points

- Pancreatic adenocarcinoma is an aggressive malignancy with a very poor prognosis despite the use of multiagent conventional chemotherapy regimens.
- The only way to gather evidence concerning changes in clinical practice outside of a typical clinical trial is by analyzing real-world prescription data.
- This study reports results from a multi-institutional retrospective analysis of prescription data from pancreatic cancer patients in the adjuvant (n = 459) and first-line palliative (n = 1308) settings. Patients can appear in several lines of therapy.
- The top three most common adjuvant therapies were gemcitabine monotherapy (43.6%); folinic acid, fluorouracil, irinotecan and oxaliplatin (FOLFIRINOX) (33.3%); and gemcitabine in combination with capecitabine (19.0%).
- FOLFIRINOX predominated in patients aged <70, whereas gemcitabine showed the highest proportion in patients aged ≥70.
- The proportion of patients treated with FOLFIRINOX in the palliative setting increased from 23.6 to 37.5%, whereas the proportion of patients treated with gemcitabine plus nanoparticle albumin-bound paclitaxel dropped slightly, from 50.0 to 45.8%.
- Patients receiving gemcitabine monotherapy were older (median age: 78) than patients receiving gemcitabine plus nanoparticle albumin-bound paclitaxel (median age: 71) or patients receiving FOLFIRINOX (median age: 62).
- Use of the FOLFIRINOX regimen declined from 60.0% in patients aged <55 to 2.3% in patients aged >75.
- By contrast, gemcitabine monotherapy increased from 5.0% in patients aged <55 to 49.0% in patients aged >75. Gemcitabine plus nanoparticle albumin-bound paclitaxel increased from 23.0% in patients aged <55 to 45.3% in patients aged >75.
- The authors' analysis suggests that findings from recent clinical studies are promptly incorporated into practice. It was striking that, during the analyzed period, the use of platinum-based therapy regimens in adjuvant and palliative first-line therapy increased predominantly in younger patients (<70 years).

Author contributions

Substantial contributions to the conception, design of the work, acquisition, analysis and interpretation of data for the work; drafting the work and revising it critically for important intellectual content; final approval of the version to be published; and agreement to be accountable for all aspects of the work: S Hegewisch-Becker. Substantial contributions to the acquisition, analysis and interpretation of data for the work; revising the work critically for important intellectual content; final approval of the version to be published; and agreement to be accountable for all aspects of the work: K Kratz-Albers. Substantial contributions to the

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Ethical conduct of research

The authors state that they have obtained appropriate institutional review board approval or have followed the principles outlined in the Declaration of Helsinki for all human or animal experimental investigations. In addition, for investigations involving human subjects, informed consent has been obtained from the participants involved.

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